

# AHRQ Grant Final Progress Report

Title of Project:

## **Enhancing Complex care through an Integrated care Coordination Information System (ICCIS)**

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**Inclusive Dates of Project:** 9/30/2008 to 9/29/2012

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**Acknowledgement of agency support:** This project was supported by grant number 1R18HS017832 from the Agency for Healthcare Research and Quality.

**Grant Award Number:** 1R18HS017832-01

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## Executive Summary

**Purpose:** Most chronic and preventive longitudinal care needs are addressed in primary care practice, yet payments and practice structure are based on visits and procedures. With dissatisfaction growing in primary care, many reform efforts have been tried, including paying for performance after achieving quality measures. However, for older adults with multiple chronic illnesses, the longitudinal coordination needs may represent the majority of care needed to improve outcomes such as reducing hospitalizations due to fragmented care and complex care plans. We tested the hypothesis that incentives for team-based care coordination would better address unnecessary utilization than traditional quality measure based pay for performance.

**Scope:** This study examined the effect of implementation and/or improvement of existing health information technology (HIT) had on the outcomes and satisfaction of patients with chronic/complex illnesses. The study was done at six ambulatory clinics/teams in both rural and urban settings.

**Methods:** Six clinics were cluster randomized into two arms: three clinics received incentive payments for documenting improvement in a set of 5 quality measures each quarter (quality) and three received care coordination payments for activities related to assessment, education, goal setting, motivational interviewing, and communication (coordination). Both clinics received extensive training in care management, coordination, and other principles of medical homes, had a designated care manager, and received health information technology that provided interactive quality reports, tracked and reminded about services, and facilitated population management based on risk. Utilization information was gathered from Medicaid payers (4 clinics) and from a global all payers database (2 clinics). Patients were deemed eligible if they were seen in the clinics at least twice in the 36 month study period. Patients were analyzed in two groups: 1) a set pre-selected based on risk of hospitalization and death (all patients); 2) the sets of patients enrolled by the care manager (Medicaid only). Due to shifting insurance coverage, gaps in sent data, and other issues, utilization metrics were not completed but are still pending.

**Outcomes:** Clinics were evaluated on their quality performance using 5 self-selected but standard (NQF approved) quality measures; by patient experience of care through before and after surveys; and will be evaluated by changes in utilization.

**Results:** In all, 26,395 patients of 87,710 total clinics patients were eligible for the study; 8,134 were preselected as high risk of hospitalization; and 3,075 were actively care managed by the clinics. Baseline characteristics of the high risk group did not vary, but clinic enrollment populations varied. The system was functional and used at the end of the first preparation year; over 35 implemented functions were identified as needs by users and were prioritized through a qualitative process. Four EHRs were used by practices, and each EHR presented a different granularity and structure of data, so variation in the initial quality and relevance of data varied. Care coordination clinics used the system to perform 1.8 times as many care coordination activities as quality, while quality clinics improved their quality measures 14.2% versus 8.9% for coordination. Experience of care did not change except for a 9% absolute increase in ease of making appointments in the coordination arm. Six month preliminary results for hospitalization bed-days and ED visits per 100 patients showed difference in difference of -17 bed-days (-24,-11) for care coordination greater than quality and - 2.2 ED visits (95% CIs -0.2, 4.5) for a quality arm trend towards better than care coordination.

**Discussion:** Building an Integrated Care Coordination system was feasible, it was used based on study assignment to improve care coordination and quality performance, but we do not yet know if it changed utilization outcomes for patients. This represents clear proof that an integrated system can be created across EHRs and used for different purposes. The granularity of data suffices to inform multiple future health reform efforts, including Accountable Care Organizations and Patient-Centered Medical Homes. The system has been adopted by several organizations for broader use since study end. Initial results show a positive improvement in quality and a mixed improvement in utilization.

**Key Words:** Primary care, Reimbursement, Care Management

## Purpose

The aim of the study was to implement and improve use of existing IT (by implementing an Integrated Care Coordination Information System, or ICCIS) in a set of six ambulatory clinics/teams (Aim1; Table 1 timeline below, in yellow), using the RE-AIM model to assess implementation success (Aim2). We tested whether it was used under cluster randomized trial under of separate incentive plans (Aim 3). Finally, we took this use data and saw whether HIT use can change outcomes for patients with complex illness by measuring hospitalizations and ED visits improves satisfaction (Aim 4).

**Table 1. Timeline for entire project**

		10/08-9/09	9/09-10/10	2010-12
<i>Aim1</i>	Implement CMP and ICCIS model			
<i>Aim2</i>	Assessment of implementation success			
<i>Aim3</i>	Cluster randomized trial			
<i>Aim4</i>	Evaluation of outcomes			

Our first issue was feasibility. Could these key components important for care of patients be implemented in a diverse set of clinics? This issue was especially important, as our research has shown that clinics adopt a subset of these uses of HIT but often fail to implement the entire set of functions represented by ICCIS. Therefore, our hypothesis for Aims 1 and 2 was:

Aim1/2  $H_0$ : An integrated system that combines key functions for care coordination *cannot* be implemented using existing CCHIT EHRs, standards, and workflow changes.

Aim1/2  $H_A$ : An integrated system that combines key functions for care coordination *can* be implemented.

The result for Aims 1 and 2 was positive; we could and did implement an integrated system. To do so, we drew data from 4 different EHR systems and extended Aims 1 and 2 across the entire study for continuing improvement.

For long term viability of any HIT solution, the system must be not only be available – it must also be useful. The primary barrier we identified was that of incentive: if either quality metrics or medical home models were adopted in a widespread manner, clinics may be better able to use health information technology to improve care. However, no one has clearly shown this to be the case. Thus, our hypothesis for Aim 3 was at the clinic level:

Aim3  $H_0$ : Clinics cannot improve their use of HIT for care coordination or quality services for patients with complex illness.

Aim3  $H_A$ : Clinics can improve their use of HIT for care coordination or quality services for patients with complex illness.

The results for Aim 3 were equally, and perhaps surprisingly, successful. Once clinics were assigned to their arms, they put their teams and care managers directly to use improving care coordination activities or quality (depending on assignment) despite receiving a minimal payment (maximum of \$36,000 over 18 months). Clinics assigned to care coordination performed 1.8 as many care coordination activities as quality; the quality arm increased their quality measures 50% more than care coordination.

For the next hypothesis, we must address whether the adoption of these techniques – requiring health information technology but also more patient-centered care coordination and quality improvement– will actually improve elements important to the patient. In this case, we have two sub-hypotheses given that the hypotheses for Aims1-3 were true:

Aim4 H<sub>0</sub>: The use of key HIT functions to provide better care coordination or quality improves neither the costs nor the patient satisfaction of those with complex illness.

Aim4 H<sub>A1(02)</sub>: The use of key HIT functions to provide better quality improves costs and/or patient satisfaction.

Aim4 H<sub>A2</sub>: The use of key HIT functions to provide better care coordination improves costs and/or patient satisfaction.

The initial answer to this question appears mixed. Bed-days declined more in the care coordination incented group, but ED visits were better in the quality arm at 6 months. Due to significant delays with data, we are unable to completely answer this question, but have leveraged institutional resources and plan to have this answered by June 2013.

## Scope

### Background

Care for patients with complex healthcare needs was in a crisis in the United States. The aging population, along with lifestyle and environmental changes, has led to rapid increases in numbers of patients who suffer from complex illnesses while the health system struggles to adapt. Some patients have complex needs that can interfere with their self-management ability, requiring a more comprehensive approach. In order to *prevent* avoidable exacerbations of health and reduce costs, a systematic approach to patients was needed. A prepared primary care team empowers such patients to establish health goals and preferences, organize, and prioritize their tasks to achieve their goals. Many patients seek care from urgent locations (e.g. the emergency room, the hospital) because *the health care system can be complex and difficult to access*. Two changes to health care teams that can provide this systematic approach, especially when combined with broader models of change, was nurse-based care management and health information technology[1-4]. A meta-analysis for redesign for patients with diabetes showed nurse care managers and team reorganization were the most successful quality improvement techniques; information technology alone was only moderately successful[3]. A care management model for depression in older adults (who tend to have more complicated depression and concurrent illnesses) demonstrated broad success[5, 6]. Patients with schizophrenia benefitted from care management with HIT using the Medical Informatics Network Tool[7]. We and others have shown reduction in hospitalizations or ED visits can occur in from models focused on older adults with complex needs[8, 9].

Studies of these models and many others have highlighted the special requirements and benefits for HIT in the care of patients with complex needs. Information technology can theoretically provide better planning, information management, and even remind clinicians about best practices, but it must be placed in an environment where it will get used. A review of more than 100 systems for chronic illness care help defined the components most crucial for success[10]. These included population management or registry functions, focused decision support, context-specific ordering, and team-based use of the system, with patient portals demonstrating some promising elements. However, researchers have identified several **barriers** to development and use of IT functions in ambulatory care.[10-13] The primary barriers stem from the lack of incentives to perform patient-centered care coordination or systematic follow-up on quality measures[14, 15]. Two major incentive packages have emerged to address these issues: pay-for-performance, where successful achievement of quality metrics was reimbursed, and pay for coordination/management (such as the Medical Home model[16]. For example, a large review of studies that compared the performance of prepaid group practices to fee-for-service (FFS) health plans suggested that prepaid group plans generally had better processes of care, excelled at preventive care, and had moderately better clinical outcomes, although they generally did worse in terms of patient satisfaction[17]. An alternative to the pay-for-performance model was to change reimbursement at the primary care level to support the creation of a medical home. Goroll and colleagues suggested a new method for reimbursing primary care physicians: rather than relying strictly on bonuses, they direct payments to primary care practices to include support for the systems and teams that they deem essential to the delivery of comprehensive, coordinated care[18].

## Context

The present study was a collaborative partnership between the Oregon Rural Practice-Based Research Network (ORPRN), Healthcare Partners (HCP), Care Management Plus (CMP), a division within the OHSU Department of Medical Informatics and Clinical Epidemiology, and six rural primary care clinics in Oregon. The three partners provided complementary skills for studying the impact of implementing health IT into practices. ORPRN served as the primary project coordinator and assisted with the process of practice transformation to integrate care managers in care delivery, HCP provided infrastructure support from their local setting and two clinics, the CMP team provided training to the nurse care managers as well as information technology support, and the clinics actively implemented and evaluated the system in their “real world” practice environments.

## Setting

Oregon Rural Practice and Research Network (ORPRN) was a statewide network of primary care clinicians, community partners, and academicians dedicated to research into delivery of health care to rural residents and research to reduce rural health disparities. ORPRN includes 42 rural primary practices which care for over 166,000 patients. In this project we propose to implement our intervention in 4 of the ORPRN clinics. The ORPRN Steering Committee approved participation in this study.

Healthcare Partners (HCP), LLC, a management services organization, manages and operates medical groups and independent physician networks nationally in its pursuit of excellent quality Research Design & Methods healthcare delivered in a dignified and compassionate manner. The organization serves more than 500,000 patients, of whom more than 100,000 were older adults.

## Participants

The 6 clinical teams selected from the participating clinics in the ORPRN and HCP networks were asked to submit lists of active (seen within the last two years) and high-risk (designated as “high risk” by the ICCIS algorithm [19]) patients that were eligible to be enrolled in care management. Each clinic was asked to target an enrollment of 250 patients.

The population of patients cared for at the four family medicine practices was weighted toward elder adults. All of the practices accepted new Medicare and Medicaid patients and private insurance covered 29% to 54% of the patients in this cohort of practices. Five of the practices have a hospital within their community, and all of the physicians in the six study practices cared for hospitalized patients. Practice care delivery models consisted of multiple clinician/medical assistant dyads. The practices varied in their experience and penetration regarding the use of disease registries and/or care managers. Three of the family medicine practices had experience using a disease registry for diabetes, two had dedicated nursing support for diabetes care, and two had nurses serving part-time in a care coordination type role. One pediatric clinic had employed an RN trained nurse to assist with care coordination for complex children (i.e., those with special needs or difficult family environments) for over 6 years. The reach and effectiveness of these programs had not been evaluated.

## Methods and Results

### **Aim1. Implement the CMP and ICCIS model to facilitate HIT use in care of patients with complex healthcare needs:**

The first year of the grant cycle was spent assessing current use of HIT in the clinics to see the current status of their implementation of the ICCIS functions (e.g., through their EHR), implementing the ICCIS components, and piloting use of the functions in the clinic.

### ***Functions of an Integrated Care Coordination information System (ICCIS)***

Achieving best practice use of HIT required that the functions of the system were readily available as well as ensuring that their use fits into the workflow. Our previous work has shown that reorganizing the team slightly to enhance care coordination can enhance HIT use, quality, *and* efficiency. The first step was to assure the right functions were available in each setting. Using techniques from User-Centered product development, the ICCIS system was developed to provide essential care coordination functions in three major phases: 1) Needs Analysis; 2) System Development; 3) System Validation.

## **Phase I: Need identification and Requirement**

A comprehensive needs analysis was conducted with end users at seven sites. These sites ranged from rural clinics to large hospitals. Needs analysis were conducted in the five following steps:

1. Gather a comprehensive list of customer needs for a care coordination system through onsite interviews;
2. Interpret the customer needs based on technological, organizational, and financial perspectives;
3. Organize the needs into a hierarchy of primary, secondary, and (if necessary) tertiary needs;
4. Establish the relative importance of the needs;
5. Reflect on the results and the process.

For assessing end-user needs, two groups were identified. The first group consists of the every-day users: physicians and nurse care-managers. The second group is the administrative and Information Technology staff that would need to install and support the ICCIS application through its life cycle. We have reported about our experience with the needs analysis in an earlier publication[20], which included describing the discussion guides used to solicit end-user needs.

Using a method from market research called “voice of the customer”, we attempted to understand the needs of end-user by extracting their voices (wants) from interview transcripts.

## **PHASE II: Building and prioritizing needs into requirements**

Given the limited resources, typical for any development team, we set out to prioritize a set of requirements to be built, based on the voices extracted from customer interviews. After grouping, translating and pruning the voices into system requirements, we devised a prioritization formula:

$$\text{Return on Investment (ROI)} = (\text{Benefit} + \text{Penalty}) / (\text{Cost} + \text{Risk})$$

ROI referred to extent of expected return for including a particular requirement in the next build of the system. Benefit was the value that implementing a particular requirement would have for the end user. Penalty was the value that development team would suffer by not addressing a requirement, such as from lowered customer perception. Cost was the amount in resources it would take to implement a requirement. Risk was a value for impact of implementing a requirement on existing parts of the system or on the development team. All five variables were scored on a scale from 1 (low) to 5 (high). The system elements were built based on the highest priority elements. Over 500 customer needs were extracted and translated into approximately 100 system requirements; 35 of those requirements that were implemented had an ROI greater than 3.5.

## **Phase III: ICCIS system pilot, design, and standards**

Usability of ICCIS was examined by recording logged user interactions with the system. The automatic system use recording allowed the ICCIS system to be studied for its usage and efficiency based on user interaction in an actual work environment. When there was a page load, data was automatically collected in real-time and stored in a log file.

Log data from October 20<sup>th</sup> 2010 to June 24<sup>th</sup> 2011 was analyzed for the usage and efficiency of ICCIS. Descriptive analysis was used to summarize user interactions and describe the usage trends of ICCIS. The duration of time spent on page navigation and user actions were determined using the time difference between two consecutive actions performed by the same user and used to analyze the efficiency of performing tasks in ICCIS and the overall efficiency of using ICCIS. Network analysis programs were used to visualize the total number of times users consecutively performed pairs of actions. Finally, the workflow of enrolling a batch of patients into care management plus was drawn out to examine its efficiency.

Results of the usability are shown below in Figure 1, which shows the number of actions during the 8 month period (Oct ‘10-June ‘11). Over 150,000 separate actions were logged during this period, mostly around the workflow of updating ‘encounters’ ( focused care coordination or quality activities) or at the patient level – mostly reviewing patient information. The ratio of “click-through” to visit was relatively high, and 62% of page views lasted < 5 seconds, indicating users were visiting some pages while en route

to others. As a result, more direct routes were identified and found, such as linking the ‘tickler’ (decision support reminders for care management) directly to edit encounters. In addition, some tasks were highly repetitive – assigning patients to care managers often took place in batches, yet the process required an individual patient look-up for each one. In one studied event, a care manager spent 55 minutes enrolling 50 patients in the study. Alternative pathways, such as an action grouping tool in quality measures, were created to address this need.

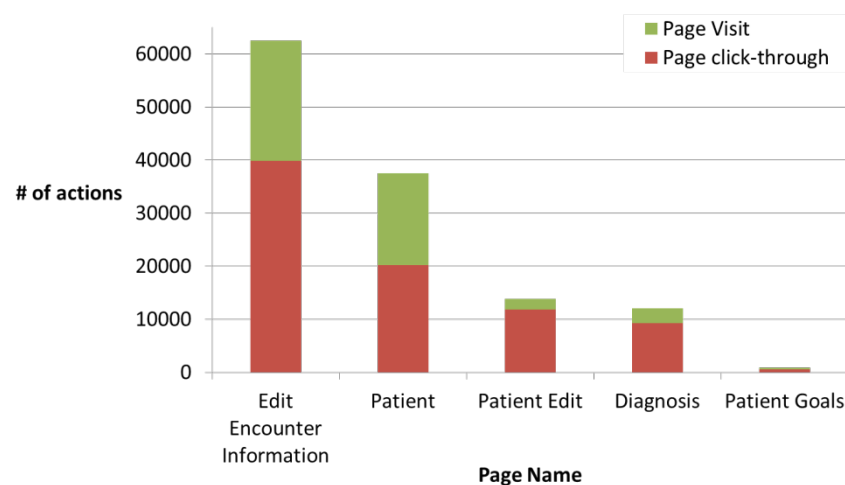


Figure 1. Number of actions and ratio of click through to visits

## AIM 2 Assessment of Implementation via RE-AIM

Assessing and implementing the HIT for the ICCIS was a complex intervention, and a multi-arm strategy was needed to test the success of its implementation. To test the effect of the program, we used evaluation tasks developed for community-based interventions; the timeline for these tasks was shown below in Table 2. Glasgow et al. recognized the need for program evaluation measurement tools[21]. His RE-AIM model assesses five dimensions of public health intervention programs: reach, efficacy, adoption, implementation, and maintenance. Success can occur at multiple levels and the RE-AIM framework was designed to measure these at individual, programmatic, organizational and policy levels.[21] We measured each of the components through a series of semi-structured interviews and carefully defined use statistics.

### Reach

In order to successfully implement the HIT components patients must be referred to the complex needs group, given a care plan, and tracked over time. To determine the “Reach” of the intervention, we tracked the number of patients who might benefit, who were referred, and who received care coordination activities. The total patients in clinic varied over the study based on the activity of patients in the panel. In this snapshot, taken at the end of the 18 month study period, there were 87,710 patients active and 3,991 referred, or 4.5%. Of those referred, 3791, or 94.9% were still active, and 119 or 2.4% were only seen by the care management team once. The latter generally meant the patient declined further care management. This reach met our goal of 2-5% of patients engaged for the study.

Table 2. Summary of enrollment

Clinic	A	B	C	D	E	F	Totals
Total patients in clinic	16,298	12,022	19,134	22,435	13,467	4,354	87,710
Arm	Care Coordination			Quality			
Total referred*	627	1635	170	820	490	249	3991
1X Only	45	65	0	2	7	0	119
Active	577	1561	150	811	481	211	3791
Maintenance	5	9	20	7	2	38	81

\* includes some ineligible patients.

**Effectiveness** - Primary effectiveness of the program was assessed using quality measures, utilization and patient satisfaction as described in Aims 3 and 4.

**Adoption-** To assess the “Adoption” of the program by clinicians we measured the relative rate of participation of the clinicians and patients/families. We conducted *semi-structured interviews* with clinicians and separately with care managers and medical assistants to seek their perceptions of the barriers and facilitators to implementing the model and factors that may have affected their participation and use of HIT. Those assigned to do care management and interact with the HIT by the clinic (frequently nurses, but may also include physicians, pharmacists, and others) were asked to describe the usability (satisfaction and ease of use) and usefulness (perceived efficacy in accomplishing tasks, effect on patients) of the intervention. Analysis were qualitative assessments similar to those previously done by the team.[22]

Results of the adoption survey are below in Table 3. We took the semi-structured interviews performed at the beginning of the study and categorized them by topic, then triangulated these results by submitting a structured interview to different groups within the clinic at the end of the study. We found significant *role differences* in the results, so the results are separated by Nurse Care managers (N=11) and clinic leaders (N=9); clinic leaders included the physician champion and clinic managers. The first 4 questions asked the respondent to rate their degree of agreement of the intervention (care manager, IT system, and incentives) had on patient and clinic outcomes. The results for these questions are summarized as the % of people that agreed or strongly agreed (responses 4 and 5 of a 5 point likert scale) that each component affected these outcomes positively. The clinics were overwhelmingly positive about the effective of each component by itself and in total, so these are given as the % across all. Thus, when asked whether study components affected patient satisfaction, only 3% of the time did anyone mark that any component did not improve satisfaction. Nurse care managers (NCM) were slightly less likely than clinic leaders to feel their efforts improved satisfaction. This was true of overall patient outcomes, patient utilization (ED/Hospitalizations), and clinic efficiency. Thus, the participants at study end felt very strongly that care management, IT, quality improvement, and care coordination could improve study outcomes. Clinic leaders felt less sure about utilization and efficiency; these were reflected in interviews where concerns about patient responsibility for ED visits was discussed and where care manager integration into broader clinic workflow was raised. In the former, examples were given of patients who did not contact the care manager after referral; opting instead to go to the ED as before. For the latter, concerns were raised about the two-tiered system within the clinic. Physicians and other providers still were largely required to see a ‘large number’ of patients in visits and incentives did not change for them; thus, they felt improvements in clinic efficiency would come with more comprehensive reform.

**Table 3. Adoption Survey Results**

Domain	NCP (N=11)	Leaders (N=9)	All (N=20)
Patient Satisfaction	95%	98%	97%
Outcomes	100%	98%	99%
Utilization	100%	92%	100%
Efficiency	99%	92%	99%
Receive Payments (from ICCIS)	36%	76%	53%
Task frequency	5%	81%	38%
Payment	100%	67%	80%
CM Task Completion	28%	21%	

The latter 4 questions were about the respondents’ knowledge and behavior around the individual study protocols. First, they were asked if they received payment directly for a variety of tasks from the study protocol. An accurate answer for ICCIS would be an average of 68% for care coordination clinics and 42% for quality clinics; expected average from these respondents would be 58%. Nurse care managers



scored significantly below expected at 36% but clinic leaders answered at a higher rate than expected. This indicates failure of the study team to communicate the precise incentives. Similarly, task frequency asked how often they changed behavior based on these payments, with a maximum possible score averaging 58% again. The lower overall score of 38% reflects the fact that most care managers noted they did not change behavior solely on individual incentives. For payment, they were asked whether the payments were sufficient. In all, 80% felt that overall payments were sufficient; it may be that simply getting paid for their general job was enough for the care managers, whereas the clinics had slightly more negative feedback. Finally, ICCIS was used to complete particular tasks 21-28% of the time. This indicates a large reliance on a single system – the EHR – to do most activity, and only switching to ICCIS when there were significant gaps. In other questions, NCMs noted they document in the EHR 89% of the time when not using ICCIS, rather than not document. It should be noted that ICCIS was used to document daily by 41% of NCMs and at least weekly by NCMs. This indicates significant influence in their workflow, even though they do not use it for every task.

## Implementation

We determined the level of fidelity to the protocol on the part of care managers and clinicians through analysis of the HIT use. We measured the percentage of patients potentially eligible for use in the system, percentage of referrals and percentage of patients seeing the care manager and the intensity and duration of the care manager contact with the referred patients. As part of the care management program, goals were explicitly described and the percentage of patients reaching these goals was measured. For the care coordination arm, the number of patients referred totaled 2,432, and the specialized clinical summaries from ICCIS were shared with 301 patients. For each, payments were limited to 250 per clinic, so clinics did far more than the payments. In all, 8,436 care coordination activities were completed across 5 categories. Again, payment was limited to 250 each, so 7.5 times as many activities were completed over what was paid.

**Table 4. Care Coordination Arm Clinics**

<b>General</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>Totals</b>
Referral to care management (max 250)	627	1635	170	2432
Explaining and sharing summaries (printing patient worksheet) (max 250)	236	65	0	301
<b>Care Coordination (all max 250 patients)</b>				
Assessment	163	446	178	624
Education	109	340	2008	2348
Goals	109	51	0	51
Communication	603	915	1774	2689
Motivational Interviewing	123	142	1475	1617

For the quality arm, they referred 1,559 patients that were counted during the study, and printed many more clinical summaries than the care coordination arm. They were largely successful at improving quality measures, improving 76 of 90 (84%) times they were given the opportunity. They tended to document far fewer activities as demonstrated by the relatively low number of quality encounters completed.

**Table 5. Quality Arm Clinics**

<b>General</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>Totals</b>
Referral to care management (max 250)	820	490	249	1559
Explaining and sharing summaries (printing patient worksheet)	374	379	5	758
<b>Quality (Number of quarters of improvement * quality measures) (max 30)</b>				

Quality measure 1-5	27 / 30	30 / 30	21/30	76/90
Quality measure query runs	170	235	0	405
Quality encounters completed	135	372	267	774

Table 4 and Table 5 both demonstrate a high level of implementation success for both the quality and care coordination arms.

## Maintenance

Within the semi-structured interviews (described above in Adoption), we asked people about their ongoing desire to use the system, participate in health reform, and continue with care coordination and/or quality improvement tasks. Of the clinics who participated in the trial, 5 desired to still continue use of the system. In the past 2 years, one switched their EHR and lost use of the system, but the rest continue to use it regularly. One institution implemented it as their primary quality improvement and care coordination tool. More broadly, it has been widely praised as helping to inform the HIT requirements of Primary Care reform efforts, such as in the Comprehensive Primary Care initiative from CMS. The ICCIS team's expertise has allowed us to be selected to lead technical assistance for this effort in Oregon and to bring aspects national, such as risk stratified care management.

## AIM 3 Cluster Randomized Trial in 6 Clinics

To test the efficacy of ICCIS, we performed a cluster randomized controlled trial RCT that took place over 18 months (using the previous 18 months as a control period for a total study period of 38 months). Our rationale for completing a cluster RCT was to understand, once an advanced IT system was available to primary care clinics, whether using it to perform general **care coordination** tasks on patients or improve **quality** measures would better improve the overall health of patients as measured by utilization/cost (especially avoiding hospitalizations and ED visits due to exacerbations of illness), patient experience of care, and quality of care. In previous studies, improving quality measures alone has had mixed and limited effects on these outcomes, and studying care coordination efforts compared to quality has not been done. **Primary Hypotheses** were divided into three groups by outcome and was summarized below:

- 1) hospitalizations and ED visits would be lower in high risk patients in care coordination clinics;
- 2) patient experience of care would be higher in high risk patients in care coordination clinics; and
- 3) quality of care would be higher in quality clinics
- 4) Secondary hypotheses were that the same effects by arm (reduced hospitalization and increased patient experience in care coordination clinics) would hold true for patients chosen directly for care management and that a trend towards reduced hospitalizations and ED visits would be found in all care managed, high risk patients regardless of arm.

## Methods of trial

**Participants** were 6 primary care clinics and the high risk and Medicaid patients seen there. Primary care clinic teams were eligible (cluster) if they saw adult Medicaid patients, employed a care manager (or were willing to hire one), and had an electronic health record (EHR) system. Medicaid patients were eligible for inclusion if they 1) were seen in the primary care clinic in the previous three years before study start; 2) were seen at least once after trial start; and 3) had 2 years of continuous Medicaid enrollment centered on the first visit after trial start.

The **intervention** consisted of three components over the 18 month trial period: 1) at the clinic level, incentives were paid to the clinic for a set of care coordination activities (care coordination arm) or quality measure improvement; 2) a trained care manager/coordinator who would perform or facilitate these activities; and 3) the Integrated Care Coordination Information System (ICCIS) interfaced with the EHRs from each clinic that provided assessments, reminders, clinical summaries, population information, and reports.

Incentives were defined based on the intent of each arm. For both arms, enrollment in care management (up to 250 patients) and sharing clinical summaries with patients were rewarded; for the care coordination arm, incentives were to complete at least one activity per patient, including assessments, goal setting and follow-up, education, communication (with anyone involved in care), and motivational interviewing/coaching. A minimum of 15 minutes was expected for each activity. For the quality arm,

clinics chose 5 quality measures from either 1) all National Quality Forum validated measures applicable to primary care; or 2) any measure used in a pay-for-performance scheme elsewhere. Incentives were paid quarterly based on activities or quality measure improvement.

The second stage of the implementation plan was training of the care manager. Care manager training was provided through Care Management Plus (CMP), a care coordination model developed by Dorr and colleagues.[23, 24] CMP redesigns primary care for patients with chronic conditions through the addition of trained care managers and robust information technology. The ICCIS implementation and training were the first training component. Each clinic received implementation and training of the software on their own patients, including the patients at high risk. Trainings occurred within the first 4 months of implementation at each site, occurring in September of 2009 for all clinics.

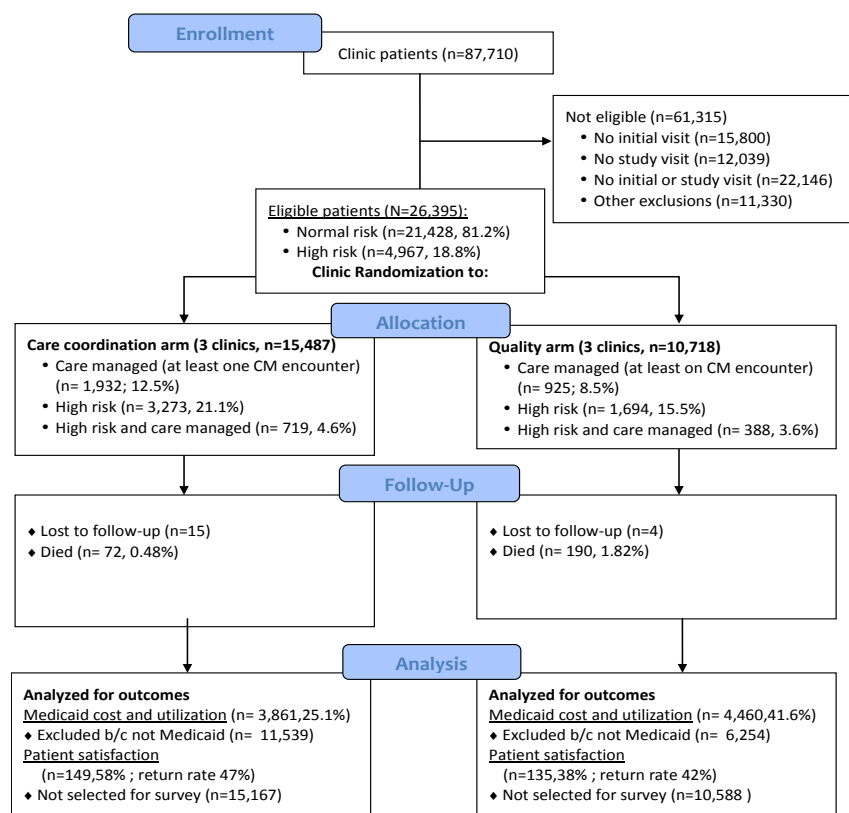
The CMP curriculum for Care Managers consists of 17-18 core modules with 10-11 additional support modules. The curriculum starts with an in-person meeting and continues using a web-based distance learning approach. In this way, care managers are able to begin using their skills while still receiving supervision and training. Cases can be discussed in an open manner and solutions found. Each care manager can also learn to better utilize community resources by collecting local resources in a web page through a facilitated learning exercise. Care managers were required to complete weekly on-line modules, reflection journals, weekly on-line discussions, and a final case presentation.

Care managers completing this curriculum were expected to be able to:

1. Teach patients with multiple chronic diseases to organize, prioritize, and implement suggested self-management strategies;
2. Identify barriers to care and intervene to overcome or eliminate these when possible;
3. Coordinate resources to ensure that necessary services was provided at the most appropriate level of care and at the appropriate time;
4. Identify patient situations at-risk for destabilization and intervene to eliminate the risk when possible;
5. Gather, interpret, and use data to identify problems and trends and to demonstrate outcomes and cost-effectiveness.

Curriculum threads for all modules included self-management, addressing barriers to care, assessing caregiver supports, end-of-life and palliative care, health promotion and community resources. Disease-specific modules include clinical care guidelines, pertinent lab data/testing, medications/dosages, drug interactions/medications to avoid, and pain management. **Randomization** was done by clinic using a computer generated random algorithm at the start of the trial. All clinics had been screened for eligibility at the time of randomization, and all were informed individually of their allocation. Clinics could not be **blinded** to allocation, since allocation drove incentives; however, the statistician was blinded to allocation for all analyses.

**Eligibility and enrollment** is provided in Figure 2.



**Figure 2. Eligibility and enrollment flowchart**

**Primary outcomes** of the trial were hospitalizations and emergency department visits. **Secondary outcomes** were preventable hospitalizations (using the PQI methodology), preventable ED visits (using NYU methodology), total costs, estimated hospitalization and ED costs, and outpatient costs.

**Sample size** was calculated at the patient level after adjustment for the ICC, and power was adequate to detect a 3% absolute reduction in the combined outcome of hospitalizations and emergency department visits. The study was approved by the local Institutional Review Board.

### ***Ongoing Assessment, Internal Controls***

During the study, we had several ongoing processes to monitor study participant and, as part of the incentive feedback loop, to reflect performance back to the clinics. Table 6 demonstrates the regular interaction with the clinics to monitor and advance the study. At all times, clinics were asked to identify patients they were actively care managing. Normally, this would be the enrolled population; however, we provided them a list of ‘high risk’ patients first and asked them to preferentially enroll these patients (if enrollment made sense to the practice). We then asked them to record their activities at least weekly; however, the majority of care managers in the study documented information at least 3 times weekly (if not daily). Activities for the quality arm were to run their reports, engage in a quality improvement activity, and document actions taken. Actions for care coordination were standard care management activities (education, communication, etc). Every month, the study team sent a report of their progress to date and anticipated payment. The basics of the reports are given in the RE-AIM implementation section, above. This provided the clinics with clear feedback about performance prior to the quarterly payment amount we sent them. At each quarter, they reviewed performance, asked for clarification or revision, and submitted an invoice for the payment. The maximum incentive was \$36,500 for documentation of activities and improvement over the 18 month study period.

**Table 6. Study monitoring and activities**

Activity	Frequency	Care Coordination	Quality
Identify care managed patients	Ad hoc	Both were required to identify actively care managed patients	

Review risk status	Once	Both given risk list, asked to review and engage high risk patients	
Document activity	Weekly	Record care coordination activities	Document quality actions
Review progress plan reports of CM activities	Monthly	Respond to team with action	
Review invoice / submit	Quarterly	Payment on breadth	Payment on quality measure improvement
Maximum incentive	18 months	Total \$36,500	

#### AIM 4 Outcome Benefit

**Data sources** included data from 4 EHRs, Medicaid claims data, obtained by agreement from the state of Oregon, and from a separate California-based all payer all claims database maintained by HCP.

**Data collection** was facilitated by ICCIS. For each clinic, data specifications were sent to IT staff for their EHR, and nightly data feeds were established for EHR-captured data relating to quality or care coordination. In ICCIS, care managers tracked active patient populations, completed activities, and used interactive reports and tools to improve their measurements. A dashboard of current incentive performance was available and updated daily.

**Analysis** consisted of descriptive statistics by allocation cluster and risk group for rates of hospitalizations, ED visits, and secondary outcomes. Chi-square tests of significance were used to compare pre and post rates for pertinent groups. Then, a two-stage multivariate analysis was completed. First, clinic level variation was calculated and intraclass cluster coefficients (ICC) were calculated. Even after ICC adjustment, the clinics had fundamentally different patient populations, so the second level of analysis used comparable patients from each clinic. This was completed in two ways. First, the analysis was limited to high risk patients from each site rather than the general population. Second, pertinent coefficients were included to account for any remaining differences. Future analyses will take a two stage approach, adding instrumental variables to encode the pertinent coefficients first, and then complete the analysis on the primary dependent and independent variables.

## Results

### Principal findings

Of the 87,710 patients in the 6 clinics, 26,395 were seen twice during the study period and were therefore eligible for the study. Of these, 8,134 (15.6%) were preselected as high risk of hospitalization and 3,075 (11.6%) were enrolled in care management. 55% of patients were female, although females were more likely to be referred to CM. High risk patients tended to be older, have more Medicaid and/or Medicare insurance or be uninsured. Patients referred to CM included 60% lower risk and 40% from the high risk group.

**Table 7. Demographic and health characteristics for patients referred to ICCIS as compared to the entire patient population and the high risk patients, from baseline data**

Characteristics	Entire Patient Population	Patients identified as "High Risk"	Patients referred to CMs (excludes ineligible)
	N	N	N
<b>Care Coordination</b>			
Clinic A	19,134 (21.8%)	1,515 (18.6%)	1,020 (33.2%)
Clinic B	22,435 (25.6%)	3,460 (42.5%)	967 (31.4%)
Clinic C	4,354 (5.0%)	495 (6.1%)	99 (3.2%)
<b>Quality</b>			
Clinic D	16,298 (18.6%)	561 (6.9%)	340 (11.1%)
Clinic E	12,022 (13.7%)	779 (9.6%)	582 (18.9%)

Clinic F	13,467 (15.4%)	1,324 (16.3%)	67 (2.2%)
<b>Total</b>	87,710	8,134	3,075
<b>Female</b>	48,707 (55.5%)	4,400 (54.1%)	1,923 (62.5%)
<b>Age</b>	42.9 (23.0)	65.8 (17.2)	54.7 (19.8)
<b>Payer</b>			
Medicaid	10,944 (12.5%)	1,287 (15.8%)	1,008 (32.8%)
Medicare	5,302 (6.0%)	1,644 (20.2%)	265 (8.6%)
Private	46,540 (53.1%)	2,583 (31.8%)	1,427 (46.4%)
No insurance**	33,848 (38.6%)	3,741 (46.0%)	1,166 (37.9%)
<b>Comorbidity risk score</b>			
0-1	79,576 (90.7%)	- -	1,851 (60.2%)
2+	8,134 (9.3%)	8,134 (100.0%)	1,224 (39.8%)

\*\* Since uninsured patients are 1/3 as likely to seek care, the algorithm undersampled this population. Other risk scores have independent variables for socioeconomic and insurance status.

After randomization, clinics varied significantly by arm, with the care coordination arm having fewer female, older, more Medicaid, and higher comorbid patients. However, after accounting for high risk patients, the differences were not significant. Patients who had continuous utilization data, limiting to high risk only, had slightly higher utilization during the year prior to baseline but the differences were not significant.

**Table 8. Demographic and Health Characteristics in Quality and Care Coordination Arms at Baseline**

Characteristics	Care Coordination		Quality		p-value
	N	%	N	%	
<b>Total</b>	15,400	59.0	10,714	41.0	<0.001
<b>Female</b>	9,132	59.3	6,781	63.3	<0.001
<b>Mean Age (years; <math>\pm</math>SD)</b>	50.5	(19.6)	47.7	(22.7)	<0.001
<b>Payer</b>					
Medicaid	3,160	20.5	1,487	13.9	<0.001
Medicaid Fee-For-Service*					
Medicare	879	5.7	1,268	11.8	
Other Federal Program	100	0.6	121	1.1	
Private	8,620	56.0	4,747	44.3	
Participating private payer*					
No insurance	5,668	36.8	4,164	38.9	
<b>Comorbidity risk score</b>					
0-1	12,186	79.1	9,183	85.7	<0.001
2+	3,214	20.9	1,531	14.3	
<b>High risk only</b>					
Patients with Medicaid utilization data	920		891		
Average hospital admissions	0.25	(0.66)	0.21	(0.53)	
Average days of hospitalization	1.12	(4.45)	0.84	(2.85)	
Average ED visits	0.77	(18.2)	0.41	(1.36)	

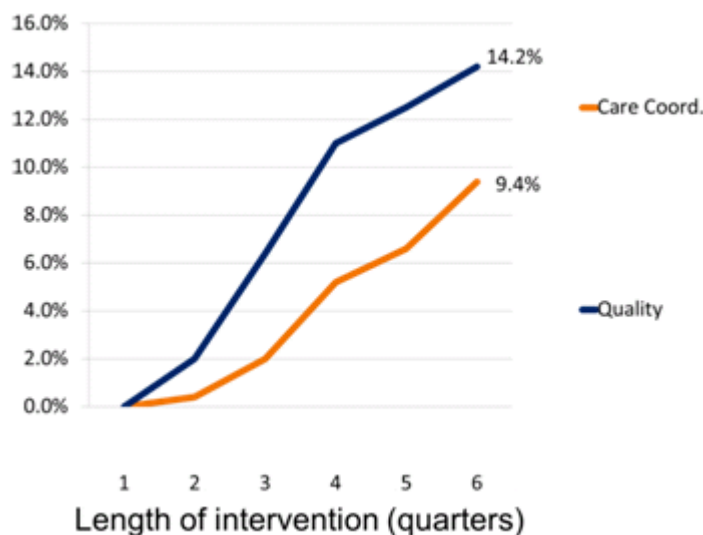
## Outcomes

### Care Coordination and Encounters

Reimbursement had a clear effect on the number and type of activities completed by each randomization Arm. Arm 1, the care coordination arm, was responsible for referring nearly 60% of the 4043 enrolled patients and completing 65% of the 12605 recorded encounters (Table 9). Additionally, Arm 1 completed 3 times as many of the activities most highly associated with the positive benefits of care management[4]. Although only Arm 2 was reimbursed for quality improvement and related activities, nearly all clinics showed improvement over the 18 month study period (**Error! Reference source not found.**). Overall, Arm 2 showed 1.5 times the absolute increase across all measures, and achieved more consecutive improvements in adherence, than Arm 1.

**Table 9. Reimbursement schedule for completed activities**

Arms reimbursed	Activity	Count	
		All clinics	Arm 1 : Arm 2
Both	Care managed patients	4043	1.3:1
	Sharing patient summaries	819	1:3
Arm 1 only	Completed encounters	12605	1.8:1
	Assessment	1176	1.8:1
	Education	2925	4.3:1
	Goals	202	1:1.3
	Communication	3820	3:1
	Motivational Interviewing	2108	1:3
Arm 2 only	Quality encounters	4440	3:1
	Quality measure query runs	1203	2:1
	Quality measure increases	119	1:1.3



**Figure 3. Quality Measure improvements by quarter**

performance improved throughout the trial. Figure 3, at left, shows the improvement by quarter of the trial as an average across all 5 quality measures per clinic for each arm. The quality group improved their measures by 14.2% absolute percentage points versus 9.4% for the Care Coordination groups. Some measures were zero at study start (cognitive impairment screening, depression screening and falls screening) and increased either modestly to 2% (cognitive, falls screening) or significantly to 37% (depression screening) absolute percentage points due to initiation of screening programs. Some process measures improved due to improvement in tracking techniques, such as an artificially low LDL cholesterol measurement each year of 20.1% to an improved 45.2% from better data entry and tracking of LDL in the EHR.

### Satisfaction

During the study period, 880 surveys were sent out and 429 were returned for a total response rate of 53%. Satisfaction scores did not change significantly except for one domain. The quality arm, at baseline, had significantly higher appointment scores (50% rating as “easy to make an appointment”) vs. care coordination clinics (33%). Difference in difference between the pre and post period was -2% to 10% for the quality arm, by domain, and -5% to 7% for the care coordination arm. The only significant

### Quality Measure Improvement

Quality measures (QM) selected by the clinics included 15 unique measures. These included 3 specific for older adult prevention (cognitive screening at 75, falls screening at 65, and 2 clinics selected advanced directives). There were 2 QM’s selected from depression screening (all patients 18+, all diabetic patients), 5 from diabetes (Pneumovax, A1c frequency, A1c control, Lipid Control, BP control), and one each from HTN (BP < 140/90), asthma (persistent asthma on controller), and CAD (History of MI on anticoagulant). Finally, two clinics choose the same measure around depression monitoring (all patients with depression who received a PHQ-9 in the last year). Quality measure

difference in results was a 9% increase for appointment ease for care coordination versus quality (difference CC: 7% - quality: -2% = 9%). This result is difficult to separate from regression to the mean. None of the clinics were reaching the 95% percentile benchmark given in the final row in Table 10 and Table 11.

**Table 10. CAHPS Results – Quality Arm**

Quality	Pre (n=97)		Post (n=135)			
Domain		Percentile		Percentile	Difference	Benchmark
Appointments	50%	50	48%	50	-2%	66
Communication	60%	0	63%	0	3%	92
Staff	79%	75	79%	75	0%	94
Tests	69%	50	79%	75	10%	91
Rating	60%	0	67%	25	7%	80

**Table 11. CAHPS Results – Care Coordination Arm**

Care Coordination	Pre (n=91)		Post (n=149)			
Domain		Percentile		Percentile	Difference	Benchmark
Appointments	33%	0	40%	25	7%	66
Communication	66%	25	63%	0	-3%	92
Staff	82%	90	77%	75	-5%	94
Tests	77%	75	83%	90	6%	91
Rating	66%	25	69%	25	3%	80

### 6 month utilization rates

Preliminary results for ED visits and hospitalizations at 6 months are given in Table 12. For this analysis, 4,338 patients were included from the care coordination arm and 9,774 from the quality arm because they had continuous coverage for 6 months before and 6 months after their study start date. For this analysis, 11.5% of patients were high risk, 89% Caucasian, average age was in mid-forties, and 58% were female. No differences between arms were seen except in the care managed population, which was higher in the care coordination arm.

**Table 12. ED and hospitalization visits at 6 months**

Characteristic	Care Coordination	Quality
Patients included	4388	9774
High risk patients	12.0%	11.3%
% Caucasian	90%	88%
Age (Average ±SD)	49.4±20.2	44.3±24.2
% female	58.1%	58.8%
Care managed	319 (7%)	195 (2%)*

\* significant difference at p<.05

In Table 13 (below), we can see that for this preliminary analysis, the care coordination arm ED visits were significantly higher than the quality arm for all patients. Despite the baseline increase in care coordination, there was no change in care coordination ED visits and a trend downward in quality ED



visits (the opposite of what regression to the mean would indicate). The overall difference in difference was + 2.2 ED visits (95% CIs -0.2, 4.5) for the care coordination – quality comparison. Although this trend is not significantly different from zero, the trend is in the opposite direction of the hypothesized care coordination effect.

For Hospital bed-days, an expected effect was seen. At baseline, the care coordination still had a higher utilization rate than the quality. Both declined in the post period; however, the care coordination group declined at 3 times the rate for a difference of -24 bed days per 100 patients (95% CI -31,-17) at follow-up versus quality of -7 bed-days (-12,0), for a difference in difference of -17 bed-days (-24,-11). Some regression to the mean is expected; however, the magnitude of the difference is greater than regression to the mean would predict and the overall difference is statistically significant. This effect was potentiated by whether the patient was referred to care management; for those patients, the difference in difference was -54 bed-days per 100 patients for care coordination versus quality (-60,-47).

**Table 13. Difference in difference at 6 months of ED visits and hospital bed days**

Group	Care Coordination	Quality	Difference
<b>ED visits</b>	<i>Rate per 100 patients</i>		
<b>Previous 6 months</b>	29.7 (26.4,32.9)	12.9 (11.5, 14.3)	
<b>Post 6 months</b>	30.0 (26.9, 33.1)	11.1 (9.9, 12.3)	
<b>Difference</b>	0.3 (-2.9, 3.6)	-1.8 (-3.2,0.4)	2.2 (-0.2,4.5)
<b>Hospital Bed Days</b>	<i>Days per 100 patients</i>		
<b>Previous 6 months</b>	110 (100, 120)	51 (45, 56)	
<b>Post 6 months</b>	86 (80, 92)	43 (39, 49)	
<b>Difference</b>	-24 (-31, -17)	-7 (-12, 0)	-17 (-24, -11)

*Analyses at 12 and 18 months are currently in progress.*

## Discussion

This study demonstrated that it was feasible to build an Integrated Care Coordination Information System across multiple different EHRs, have it used in regular clinic workflows, and be sustainable over time. As well, it demonstrated that such a system could be used to test varying incentive programs in conjunction with training in a cluster randomized controlled trial. When comparing care coordination to quality improvement incentive models, the tool allowed granular assessment of performance in the incentives and facilitated important behavior change. Those allocated to quality achieved 51% higher quality improvement than those randomized to care coordination, and those completing care coordination documented 1.8 times as many care coordination activities and 20% more referrals to care coordination.

Ultimately, the purpose of new incentive programs is to drive outcomes, and the study demonstrated preliminary but mixed results in that regard. Hospital bed-days did decline in the first 6 months in the care coordination group over the quality group, but ED visits did not decrease for care coordination but did for quality. Patient satisfaction with care was not improved overall except for ease to make appointments in the care coordination group. Additional time is needed to complete analysis for the longer term outcomes at 12 and 18 months; historically, these outcomes are more likely to be positive for the primary population.

**Generalizability/Significance** A major benefit of this study is that many of its elements are immediately useful. With health reform in Accountable Care Organizations and Primary Care Medical Homes / Comprehensive Primary Care, many stakeholders are looking to ways to maximize care coordination and care management across entire populations. Although most endeavors look to HIT to monitor programs, exchange data to where it is needed, and track new metrics across outcomes, few have had experience in building integrated population management systems to do this. The results of this study can help others complete these tasks. Others have started to use the system just for this purpose. In the Comprehensive Primary Care initiative, 7 regions of the country are provided incentives to perform risk stratified care management on population. Through our work in ICCIS, our research team is providing technical expertise for how you can implement these systems uniformly across EHRs. For Accountable Care

Organizations, the State of Oregon's Health Policy implementation group has evaluated ICCIS to understand how to roll out its version of ACOs called Care Coordination Organizations. In all, this study was extremely generalizable and useful in showing how to advance these and related efforts.

**Limitations** There are several limitations to this study. The first and most important is the small numbers of clusters. With only 6 clinics, differences in populations at the clinic cluster level become increasingly important. Others have opined that increasing the number of higher level clusters (clinics, here) can reduce the effects of Intracluster Correlation on the study. However, this study had a feasibility aspect, attempting to understand if it was possible to do a trial of this type and understand what was happening within the clinics. A smaller number of clusters were required to complete the feasibility study; it does, however, weaken the results. We account for this by using the high risk population to even the overall population's differences, and by completing a difference in difference design. Future analyses will also use two stage designs – such as instrumental variables – to account for these differences. The second limitation is the very significant contemporaneous trends in the US. For everyone, 2009-2011 represented a very large recession in the US, and health care started to change dramatically with the passage of the Patient Protection and Accountable Care Act. Some of the major findings may have been affected by these two trends, leading to significant turmoil across the sites and favoring the null hypothesis.

## Conclusions

Reimbursement for care coordination and quality pay-for-performance both improved adherence to quality metrics, with quality pay-for-performance showing double the improvement in absolute adherence rates. Changes in utilization and efficiency by incentive arm are preliminary but mixed; hospital bed-days declined more in the care coordination arm but ED visits trended down only in the quality arm.

Despite older adults being only 20% of the population in this clinic, they represented a majority of at risk patients. The clinics did refer them at a greater rate than the population, but not in proportion to their risk. Quality measure improvement for older adults was slightly less overall.

## List of Publications and Products

### National/ International Conferences

#### *Completed*

1. Behkami NA. Dorr DA. Daim TU. Modeling Healthcare Information Technology (HIT) Adoption using Systems Dynamics. CORS-INFORMS International Conference. Toronto, Canada. June 14, 2009.
2. Dorr DA. Behkami, NA. Application of Engineering & Technology Management Practices to University R&D Research in Sustainable Healthcare Information Technology for Primary care Clinics. Portland International Center for Management of Engineering and Technology (PICMET) 2009 Conference. Portland, OR. August 5, 2009.
3. Dorr DA. Care Management for the Older Adult. Oregon Geriatrics Society Annual Conference. Sunriver, OR. October 11, 2009.
4. Behkami NA. Dorr DA. User Centered Design in Complex Healthcare Workflows. American Medical Informatics Association (AMIA) 2009 Annual Symposium. San Francisco, CA. November 18, 2009.
5. Brunker CP, Dorr DA. Widmier L. care Management Plus: Meeting the Requirements of the Advanced Medical Home. Workshop. NCOA-ASA Aging in America Conference 2010. Chicago, IL. March 16, 2010.
6. Dorr DA. Improving Healthcare Quality and Efficiency through Systematic Longitudinal care for the Chronically Ill. Poster. International Forum on Quality & Safety in Health care, Nice, France. April 20-23, 2010.
7. Dorr DA. Integrated care Coordination Information System: a tech-driven solution to improve care for older patients. AHRQ Annual Health IT Grantee & Contractor Meeting 2010. Washington, DC. June 2, 2010.

8. Behkami NA, Dorr DA, Brunker, CP. care Management Plus: A Hands-on, Tech Driven Solution for Older Patients. Scientific Demonstration. MEDINFO 13th World Congress on Medical & Health Informatics. Cape Town, South Africa. September 12-15, 2010.
9. Behkami NA, Dorr DA, Morrice S. A Business Case for Health IT Adoption: Effects of “Meaningful Use” EHR Financial Incentives on Clinic Revenue. Student Paper. MEDINFO 13th World Congress on Medical & Health Informatics. Cape Town, South Africa. September 12-15, 2010.
10. Olsen GS, Dorr DA. Clinical Benefits of Co-implementation of an Integrated care Coordination Information System, Quality Improvement, and Intensive care Management. International Society for Quality in Health care (ISQua) 27th International Conference. Paris, France. October 13, 2010.
11. Behkami NA, Daim TU, Dorr DA. Capability Maturity Model: The Case of care Coordination and HIT Adoption. 2010 Institute for Operations Research and the Management Sciences (INFORMS) Conference. Austin, TX. November 7, 2010.
12. Dorr DA, Bates DW, Steele A, Zai A. Primary care Management and Medical Homes: How to Better Leverage Informatics to Achieve Great Outcomes. Panel. American Medical Informatics Association (AMIA) Annual Meeting. Washington, DC. November 14, 2010.

#### **Presentations:**

##### *Completed:*

1. Dorr DA. Care Management Plus: A Hands-on, High Tech Approach to Complex care. University of California, Davis. Davis, CA. August 11, 2010.
2. Dorr DA. High Value Elements of the Medical Home and Other Reforms: The Example of CM+ and HIT. Centura Health. Englewood, CO. August 26, 2010.
3. Dorr DA, Lepis A. Clinical Decision Support: Process and Application. Epic User Group Meeting. Verona, WI. September 20-22, 2010.
4. Dorr DA. Introduction to Clinical Transformation Process: Primary care Redesign and Health Information Technology. Beacon Communities National Meeting. New Orleans, LA. October 13-14, 2010.
5. Dorr DA, Brunker CP. IT-enabled Primary care Models for Management of Chronic Disease. Beacon Communities National Meeting. New Orleans, LA. October 13-14, 2010.
6. Brunker CP. Quality Measures to Improve care of Seniors and People with Chronic Conditions. Department of Medicine Strategic Leadership Committee, Intermountain Healthcare. Salt Lake City, UT. Oct 15, 2010.
7. Dorr DA. Delivery System Redesign, Health Policy, and Health Information Technology: Experience of care Management Plus. Oregon Health & Science University Grand Rounds. Portland, OR. December 21, 2010.
8. Dorr DA. Delivery System Redesign, Health Policy, and Health Information Technology: Experience of care Management Plus. OHSU Department of Medical Informatics & Clinical Epidemiology. Portland, OR. January 20, 2011.
9. Dorr DA. CM+ Current Efforts: ICCIS & Other Grants. Presentation to care Management Plus Learning Community care Managers and Invited Beacon Communities via Web Conference. February 10, 2011.
10. Yackel, T. R.; Dorr, D.A.; Behkami, N. A. Future of Meaningful Use and care Coordination: Stage 2. Annual Conference of the Healthcare Information and Management Systems Society. Orlando, FL. February 21, 2011.
11. Dorr DA. The impact of care coordination versus pay-for-performance incentives on utilization at 6 months: the ICCIS cluster randomized controlled trial. Academy Health 2012 Annual Research Meeting. Orlando, FL. June 25, 2012.

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1. Behkami NA, Dorr DA. User centered design in complex healthcare workflows: the case of care coordination and care management redesign. AMIA Annu Symp Proc. 2009; November 2009: 39-43.

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